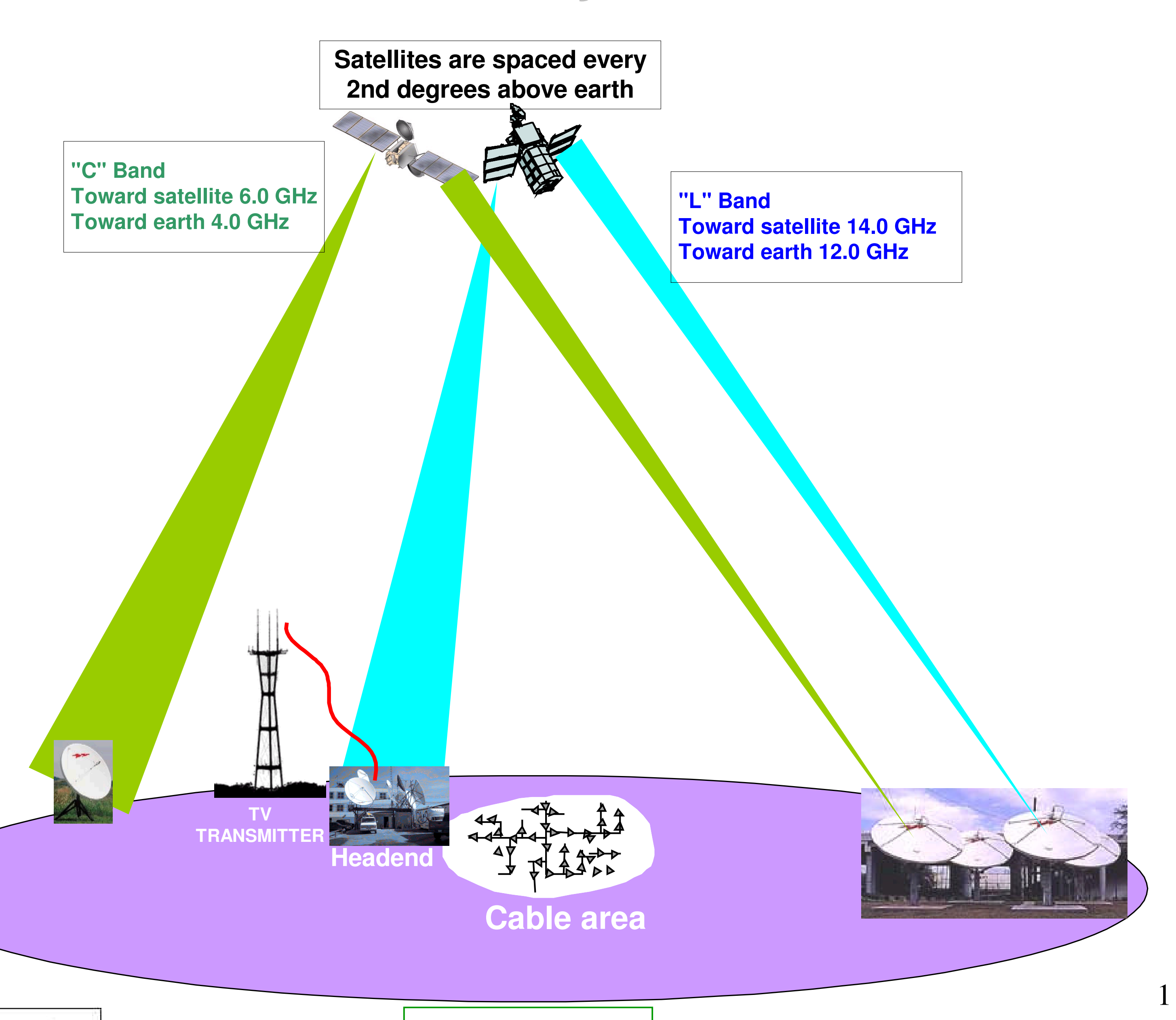
Broadband System - A



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CATV - 101.

Broadband System - A

To give you plenty of time to read the details of each presentation, you'll need to press the RIGHT ARROW KEY on your PC, so you have access to the next slide and all future presentations.

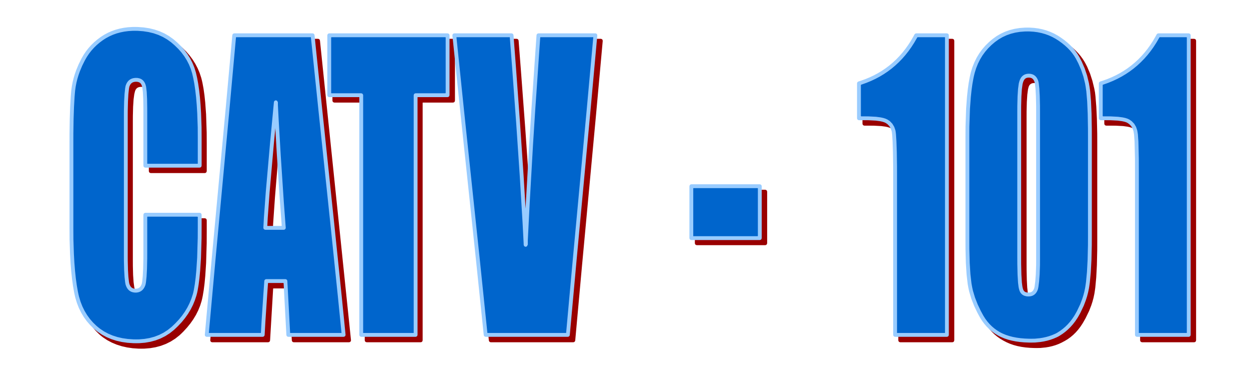
Broadband System - A

Before we start the Seminar on Broadband system, let have a look at the beginning of the CATV industry.

This will help you better understand what are the requirements for to-day's Broadband System.

This presentation is only a general idea and every subject demonstrated in this presentation will be explained in more details in future presentations.

Broadband System - A



Broadband System - A



CATV then

CATV : Community Antenna Television

CATV systems started in around 1952 and were a one way communication system, using coaxial cable and RF amplifiers. These CATV system distributed television signals, from a distribution center (Headend) to all the homes in a the cabled area.

Then, these systems were capable of only distributing between 2 to 4 TV channels. From been able to distribute 2 to 4 TV channel at their start, some of the systems finally carried as much as 12 television channels and some FM music.

CATV Licencing

In both country, Canada and the USA, you required a license to operate a CATV system.

In the United States, the cities give the permit to operate a CATV system and the FCC controls the technical data.

Federal

Communications

Commission

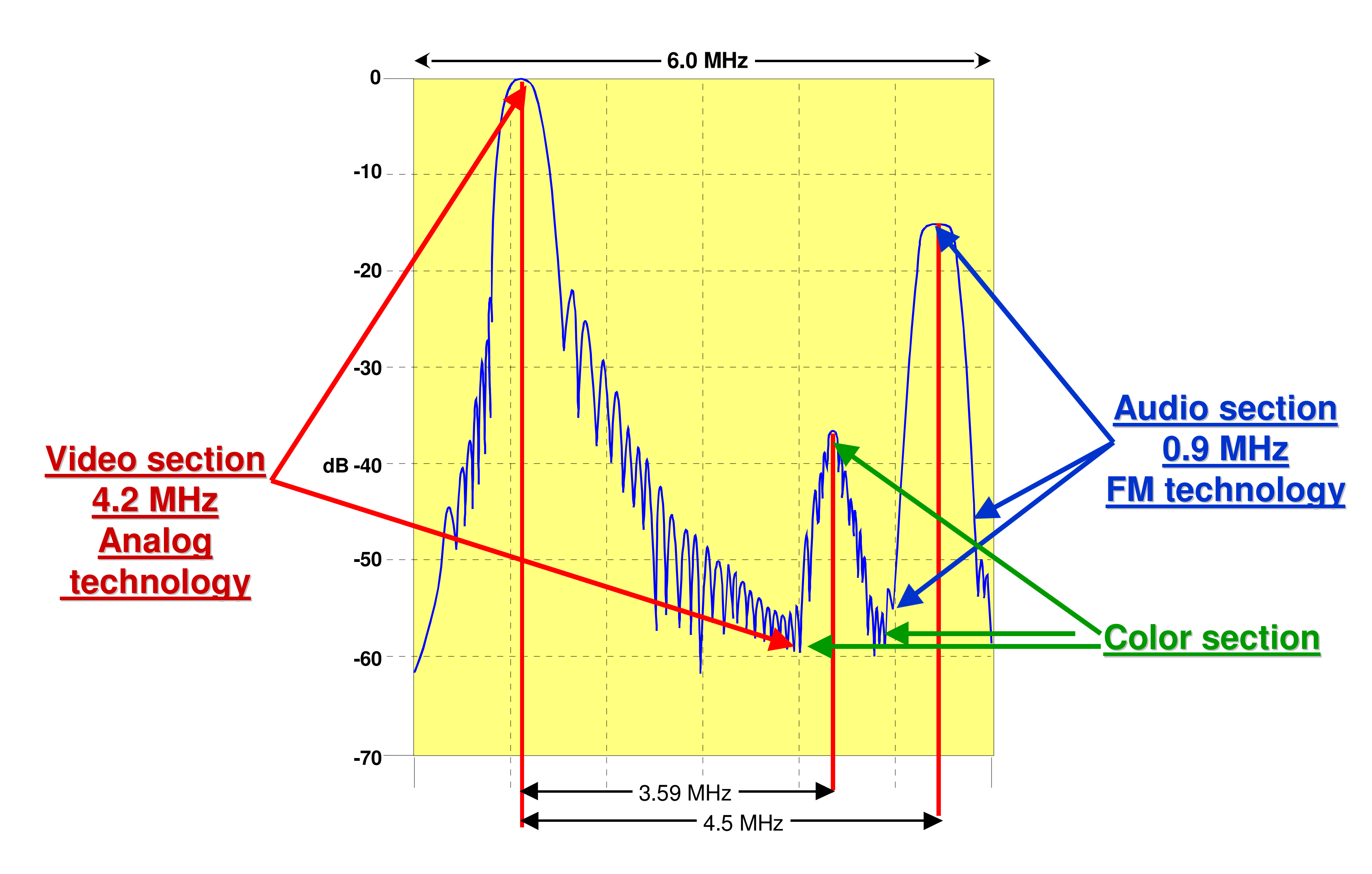
In Canada, the license is warded by the CRTC

- **Canadian**
- **Radio**
- **Telecommunications**
- **Commission**

Television Signals Comes From;

- TV Stations, VHF or UHF.
- FM Stations.
- Satellites, 4 and 12 GHz (around 1975).
- AML (microwave system).
- TV Program from local studio.

Spectrum View of a Analog Television Signal.



Over the air, TV Signal.

VHF Television Signal.

CH-2 : 55.25 MHz	CH-7 : 175.25 MHz
CH-3 : 61.25 MHz	CH-8 : 181.25 MHz
CH-4 : 67.25 MHz	CH:-9 : 187.25 MHz
* 73.5 MHz Int. disaster freq.	CH-10 : 193.25 MHz
CH-5 : 77.25 MHz	CH-11 : 199.25 MHz
CH-6 : 83.25 MHz	CH-12 : 205.25 MHz
FM : 88 to 108 MHz	CH-13: 211.25 MHz

*** Notice, the difference in frequency, between CH-4 and CH-5, which is not a multiple of 6 MHz. The reason being, that 73.5 MHz is allocated as an international disaster frequency, that is used by the Red Cross and some other international organization.**

Over the air, TV Signal.

UHF Television signal.

CH-14 : 471.25 MHz to CH-69 : 805.25 MHz

All UHF signals, like the VHF signals, are located in a 6.00 MHz spacing, the UHF stations are located between 471 to 810 MHz.

UHF channel, CH-37, 609.25 MHz, in generally not used as it is employed for Radio Astronomy.

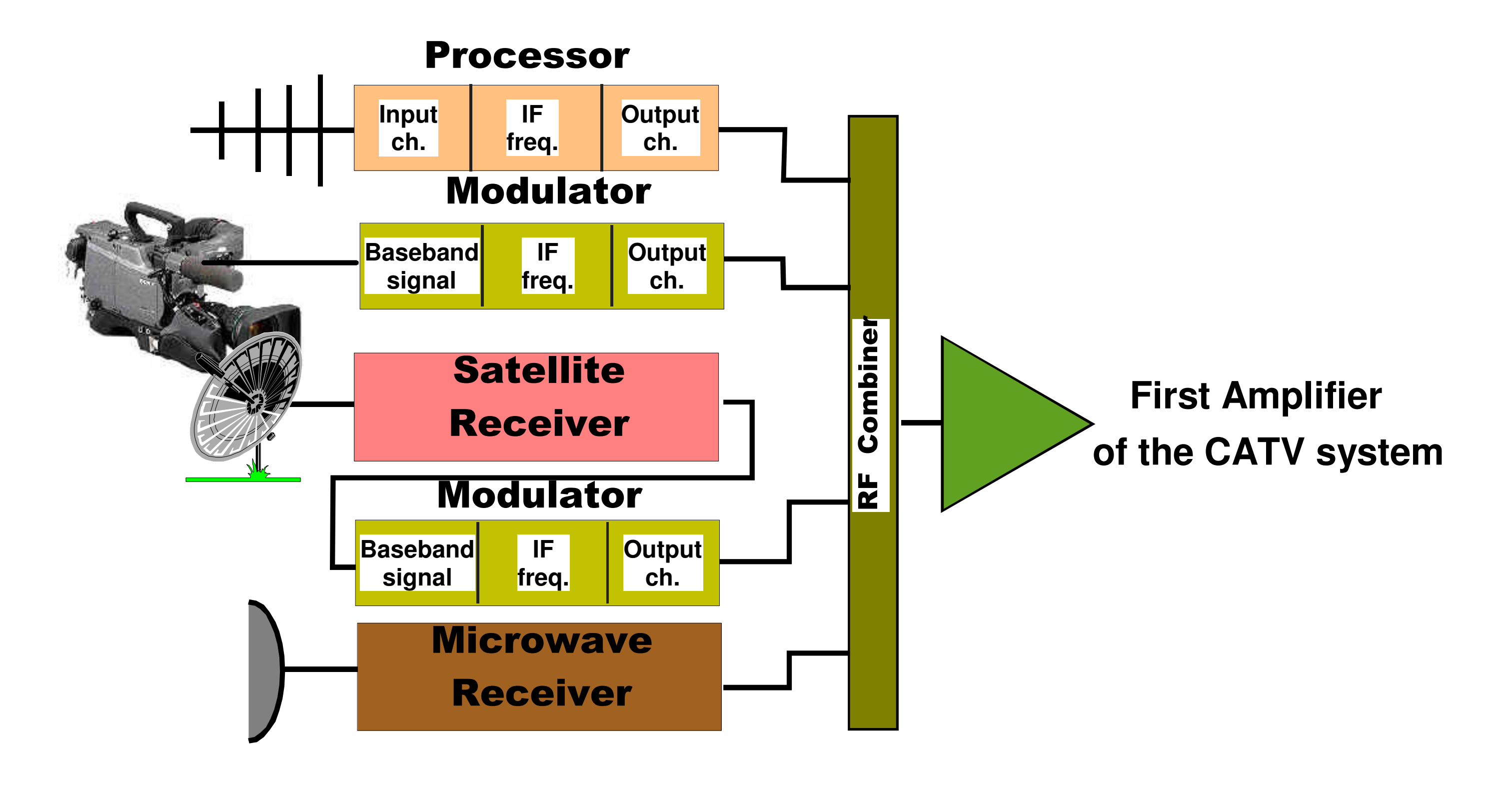
CATV Headend.

Each television channel leaving the headend are controlled by;

- **Channel processor, (RF in, RF out)**
- **Modulator, (Baseband in, RF out)**
- **Satellite Receiver, (4 or 12 GHz in, RF out)**

All the television channels are then combined together with a channel combiner before they are sent to the coaxial system.

Headend Combining Network



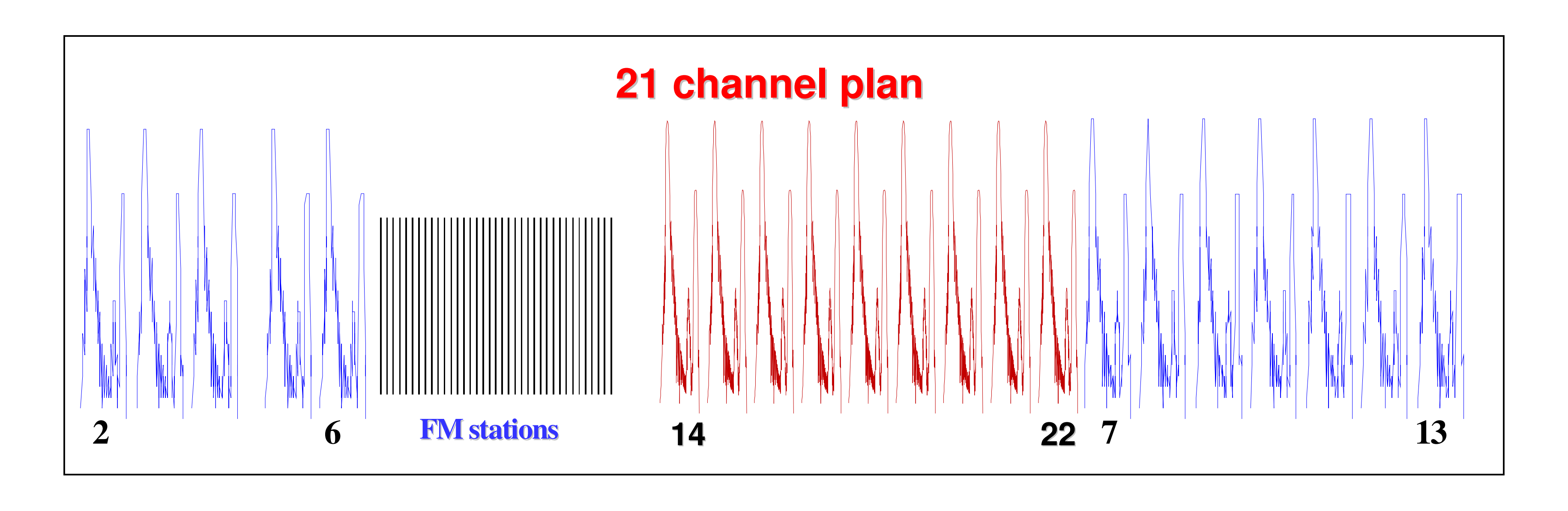
Combining Signal at a CATV Headend

CATV, VHF Channels and FM station



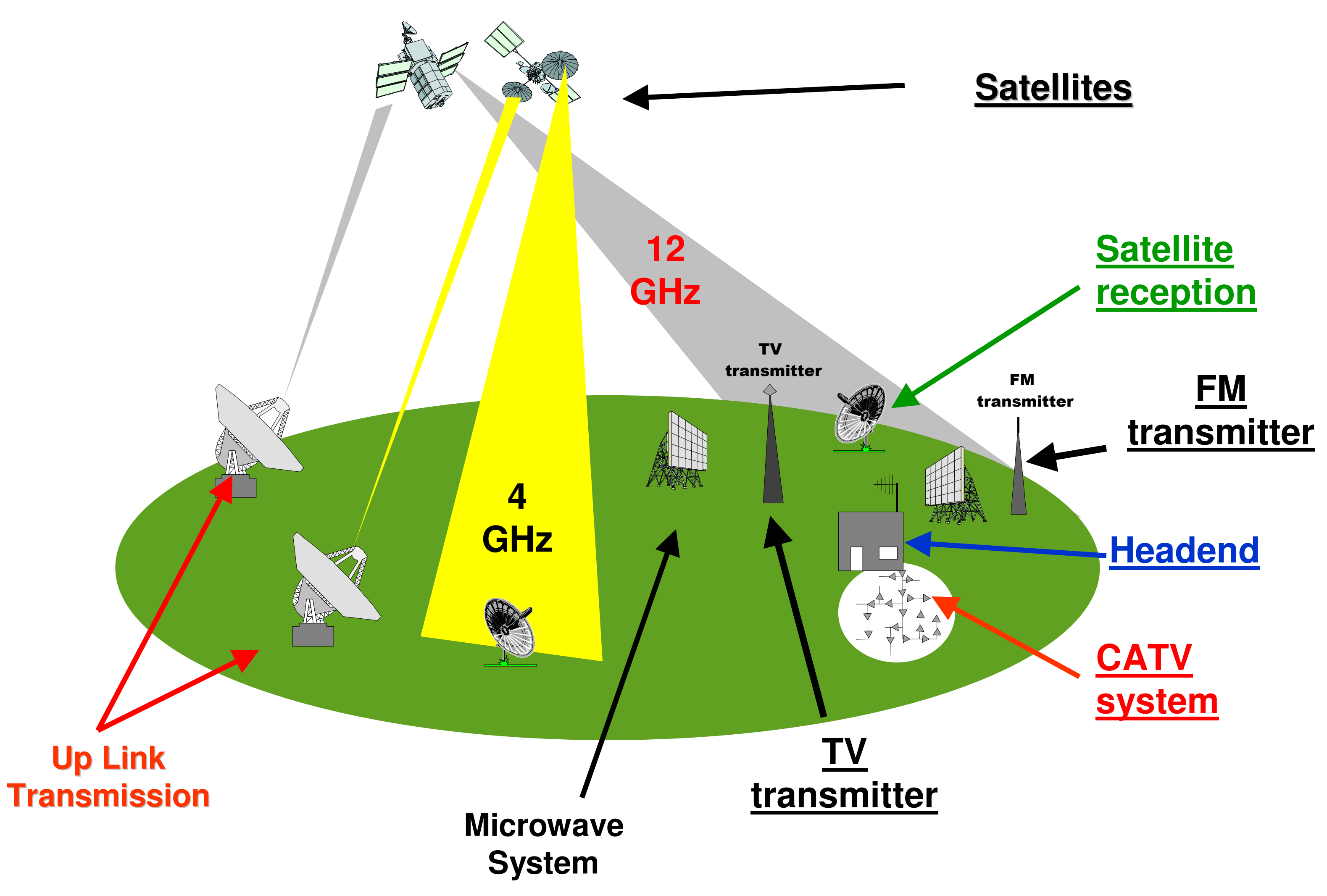
This number television channels (12) was the maximum possible before the delivery of Push Pull amplifier.

CATV, VHF Channels and FM station

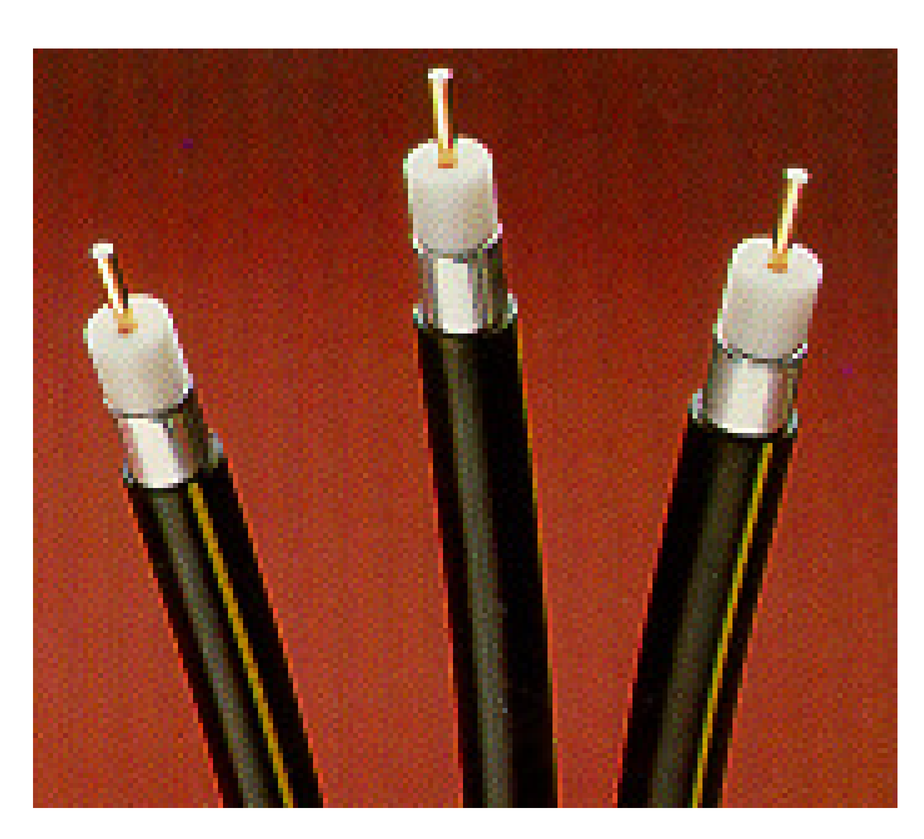


With Push Pull amplifier, it became possible to carry Mid Band channels (9) between 121 to 170 MHz, for a total of 21 channels

Where does Television Signals Comes From.



Coaxial Cable.



Coaxial cable consist of :

- 75 ohms cable.
- Center conductor.
- Foam (hold the center conductor in place)
- Aluminum tube.
- Sometimes covert with PVC jacket.

Coaxial cable is the most common way to distribute television channel.

- **It frequency range is from 5 to 1000 MHz**
- **It is also capable of handling 90 Volts AC requires to operate RF amplifiers.**

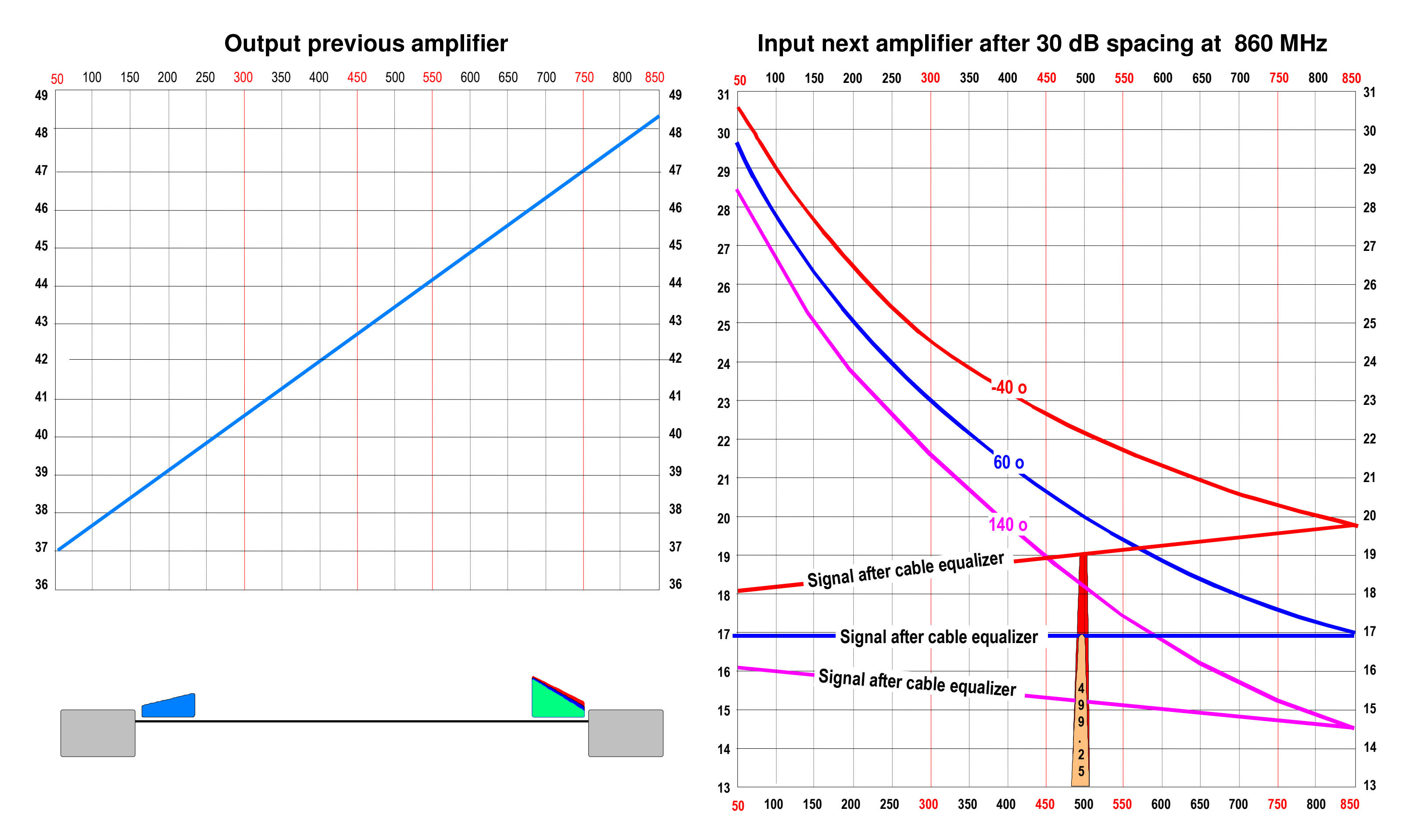
Coaxial Cable Signal Loss.

TYPE	5	50	300	550	865	1,000	MHz
Main coaxial cable:							Loss
P-III-500	0.16	0.52	1.31	1.82	2.33	2.52	dB/100’
P-III-625	0.13	0.42	1.08	1.51	1.94	2.07	“ “
P-III-750	0.11	0.30	0.78	1.25	1.60	1.74	“ “
Main drop installation cable:							
RG-59	0.86	1.95	4.45	5.95	7.52	8.12	“ “
RG-6	0.58	1.53	3.55	4.90	6.10	6.55	“ “

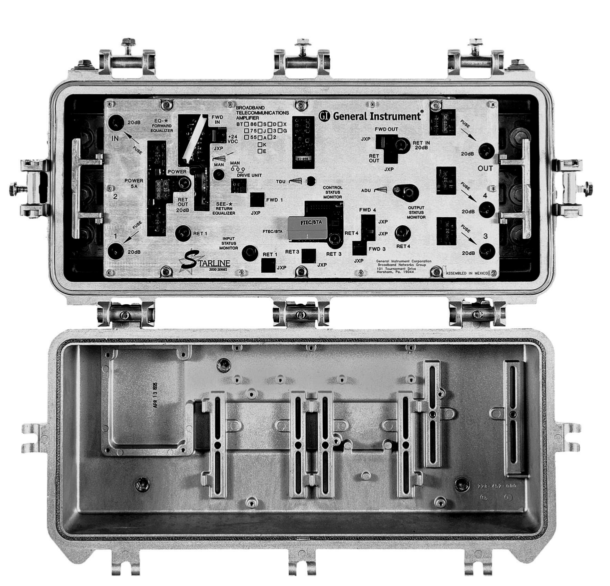
Above loss are giving @ 68 degrees F. or 20 degrees C.

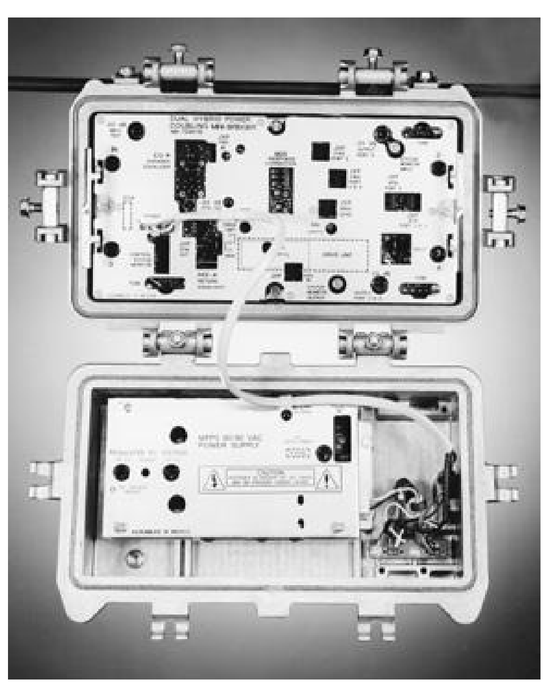
Behavior of Coaxail Cable with Temperature.

Behaviour of the coaxial cable response versus temperature change



RF Amplifiers

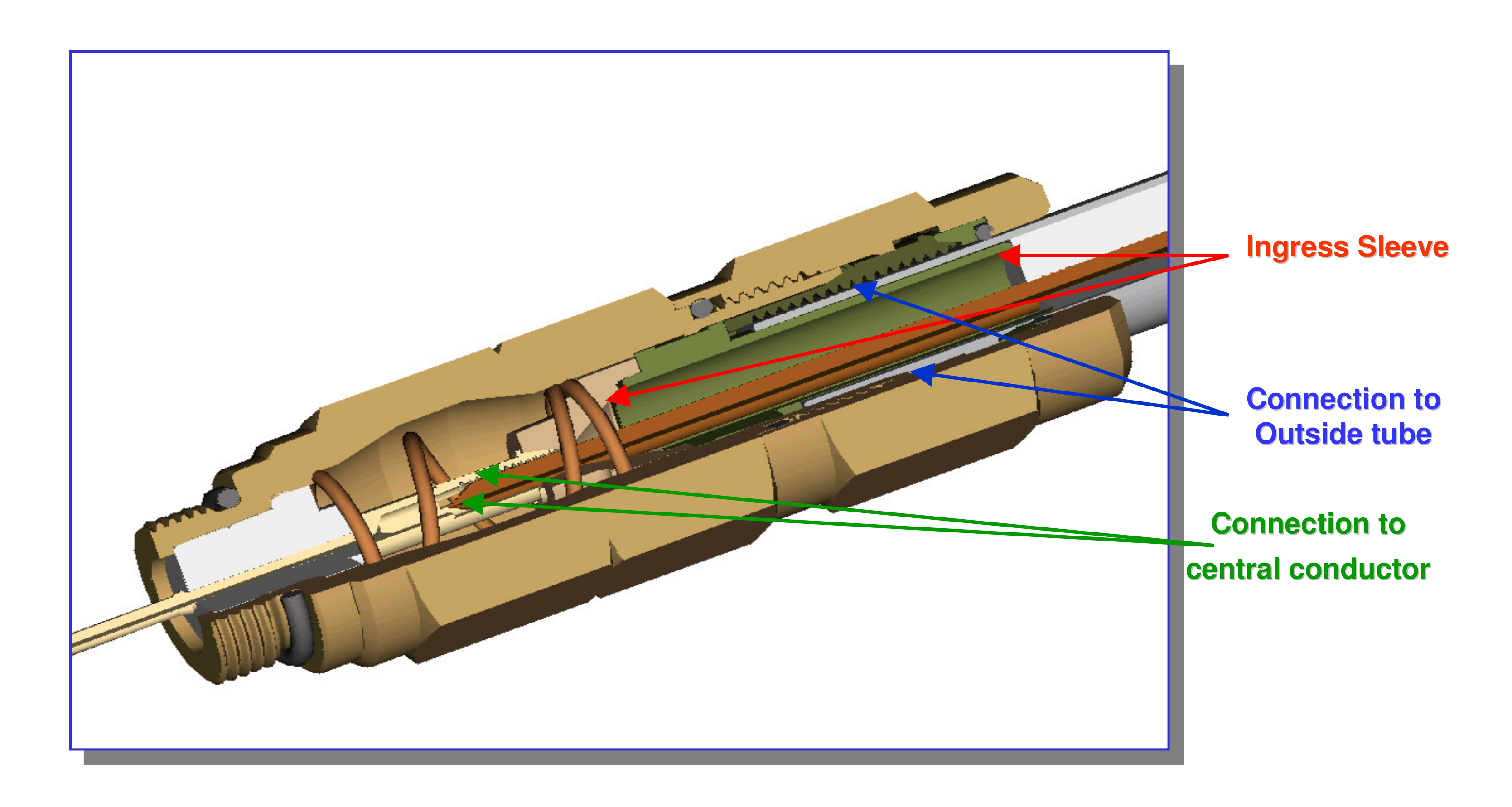






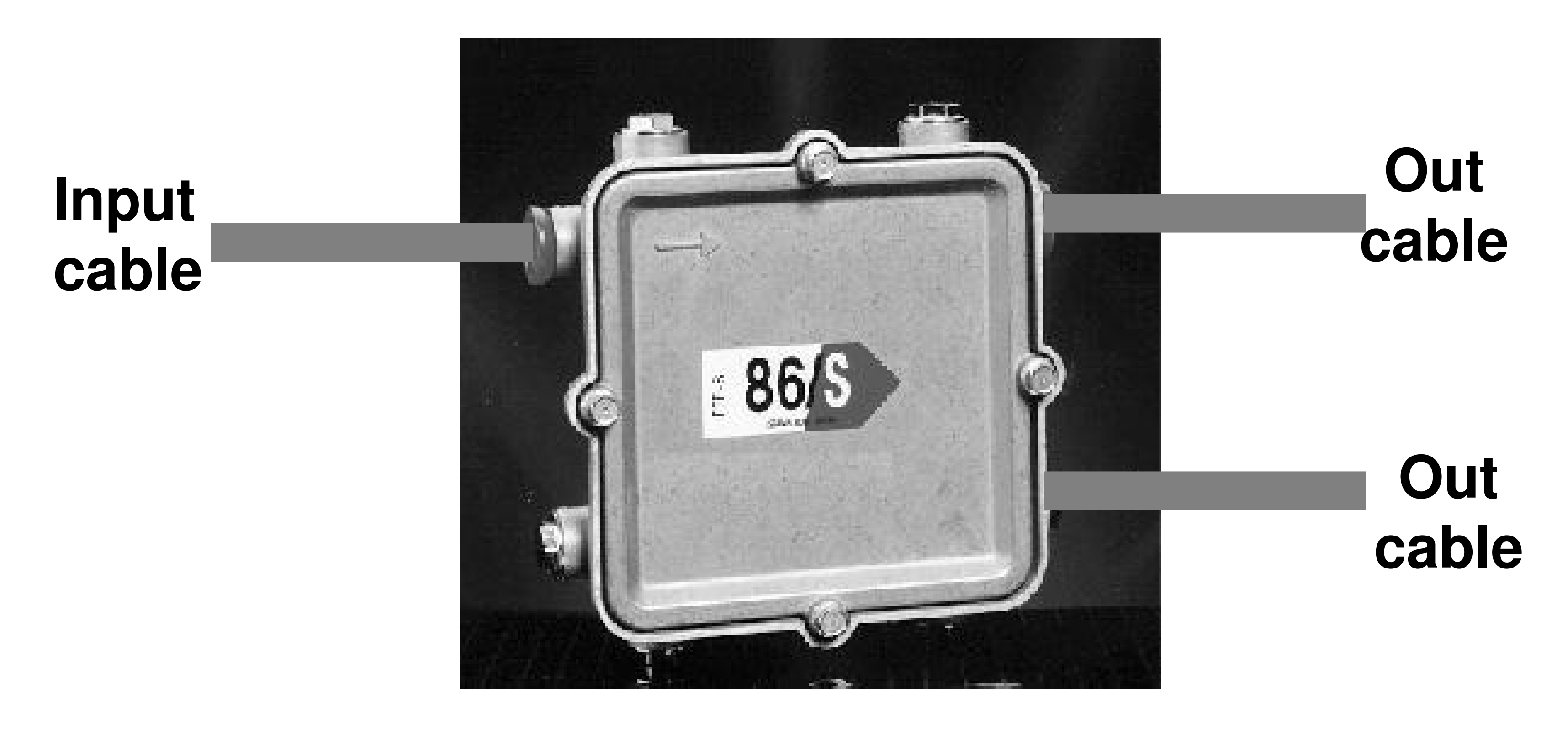
RF amplifier amplifies the signal when it becomes weak

Coaxial Connector



Connectors are required to make a connection between the amplifiers and the passives equipments on the coaxial cable.

Coaxial Cable Splitter & Coupler.



RF splitter and coupler give the possibly to send signal into two or more directions.

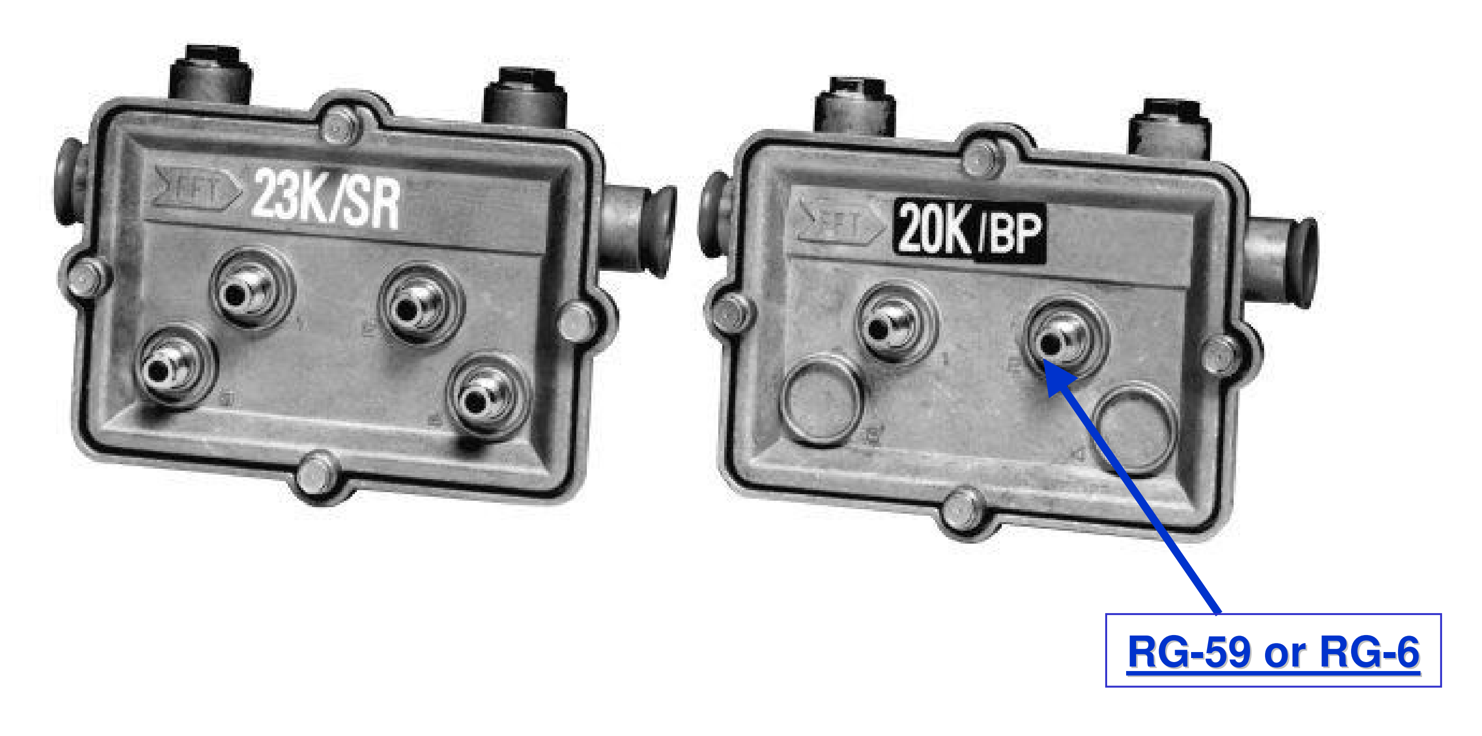
Powering the System.



Standby power supply are working on 110 volts AC or 36/48 Volts DC

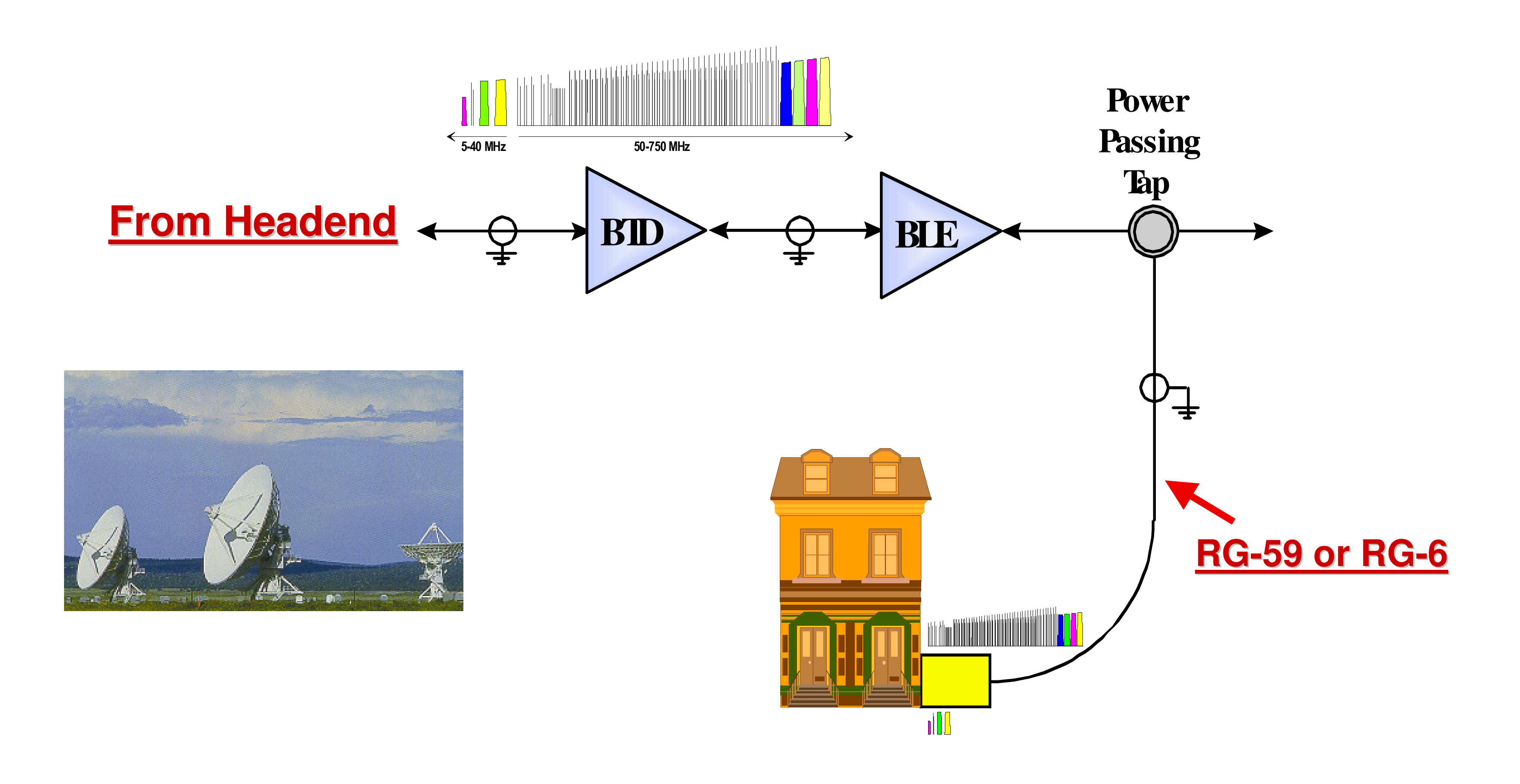
Power supply delivers 60 or 90 volts AC thru the coaxial cable, to permit RF amplifiers to work. They can be Non-Standby and Stand-By

Multitaps



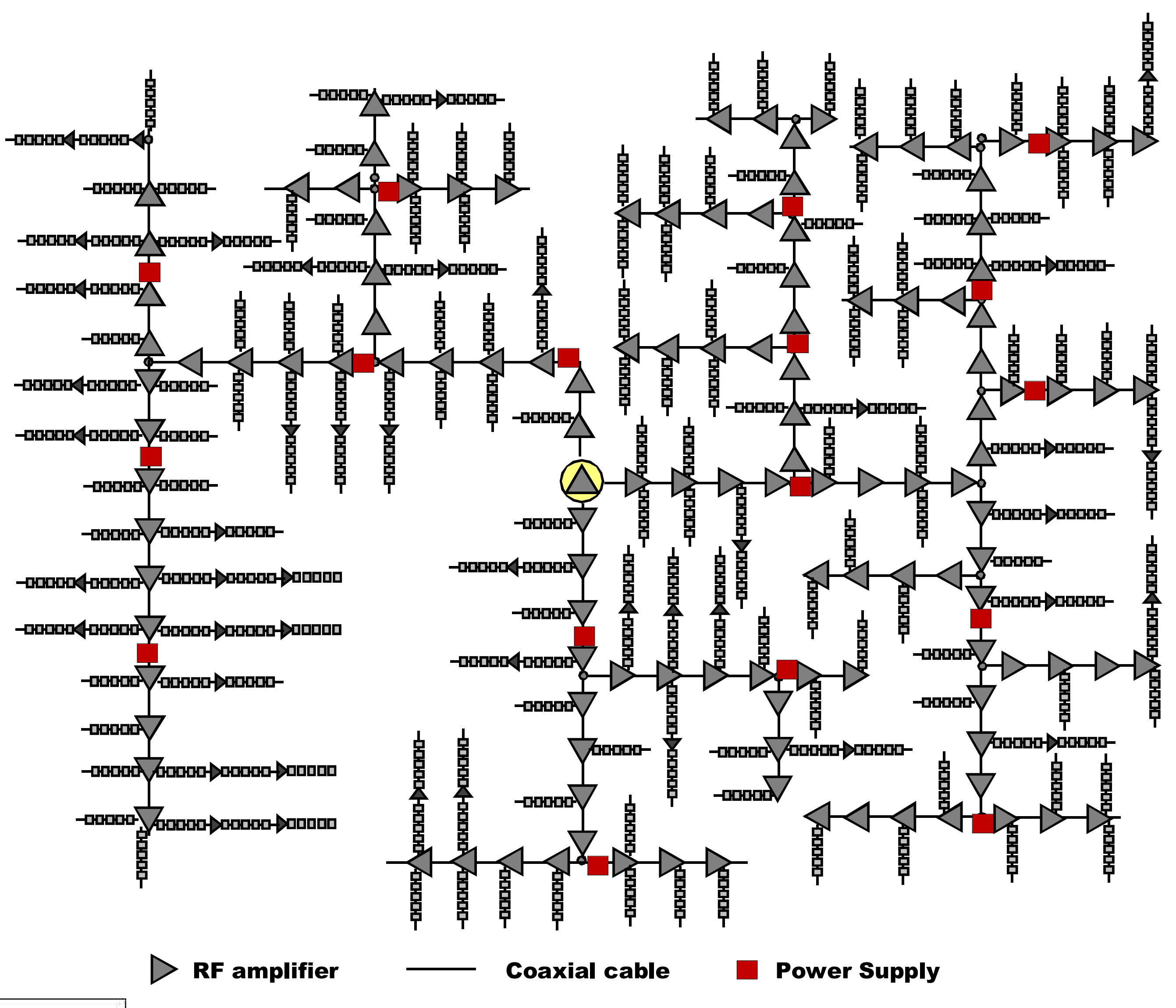
Multitap make the connection between the CATV system and the customer equipment.

Connection to the home.



A CATV system

CATV, One Way System.



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Broadband system today.

Broadband System.

Broadband CATV systems are now a very complex, Bi-directional communications network, called; HFC (Hybrid Fiber Coaxial) using Fiber Optic and Coaxial Cable technologies.

These systems are now delivering the following;

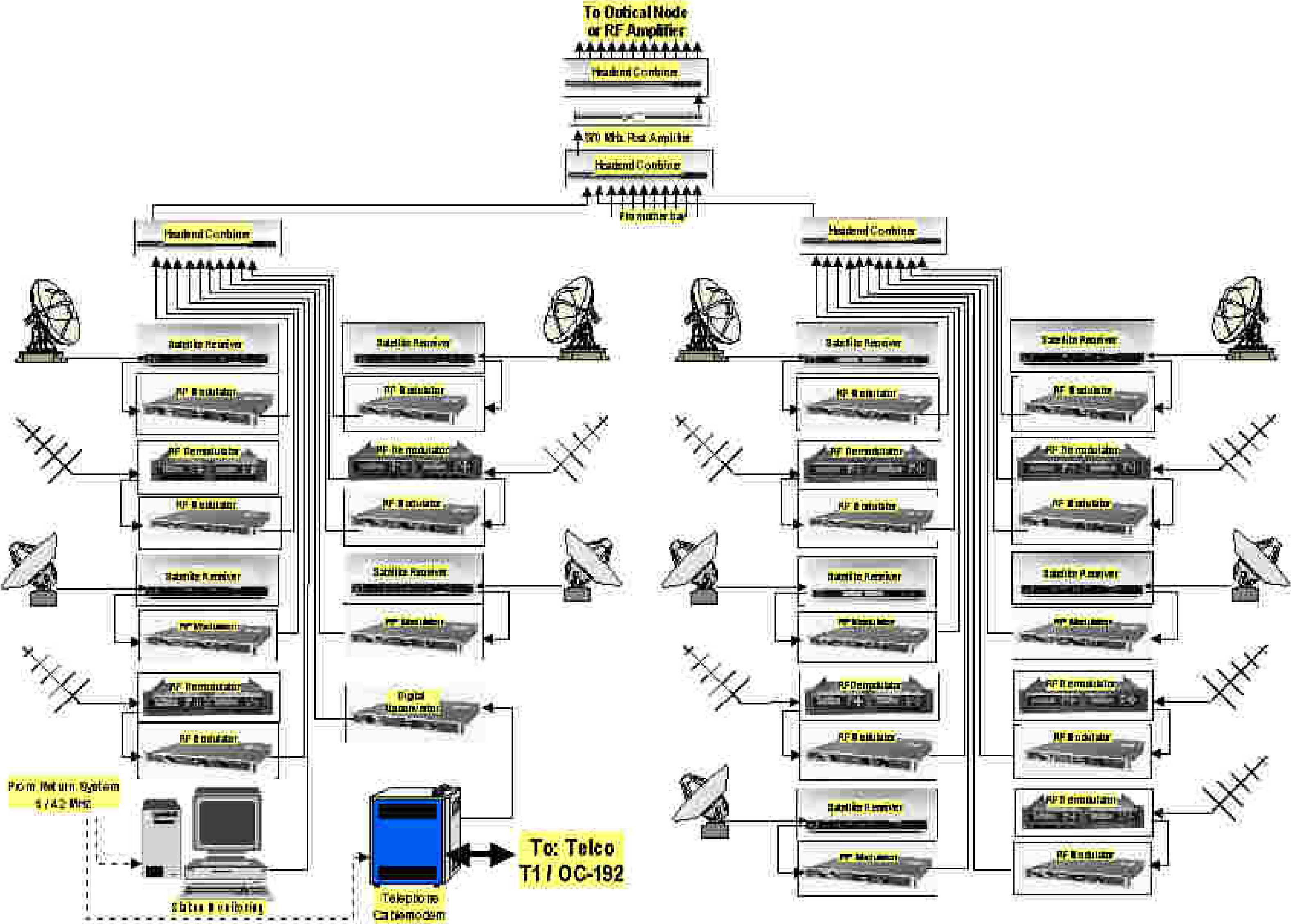
- **Analog Television programs.**
- **Television on demand or pay per view television.**
- **Digital Television.**
- **HDTV (High Definition Television).**
- **High speed Internet service, by Cablemodem.**
- **Security system.**
- **IP telephony (VoIP).**

Broadband System.

HFC Broadband systems are using fiber optic technology to transport the signals for the longest distance, between the headend to a NODE (optical receiver). The node transfers the light signal to RF signal. The signals then continue thru the coaxial system to feed all the customers. The coaxial system permits to deliver the signals at less cost. Fiber optic delivers a better quality signal than coaxial cable, this is why fiber optic is used to transport the signal for the long distance.

A HFC system is a bi-directional system, and the working bandwidth from the headend to the customer is: 50 to 870-1,000 MHz, and from customer to the headend is: 5 to 40 or 42 MHz.

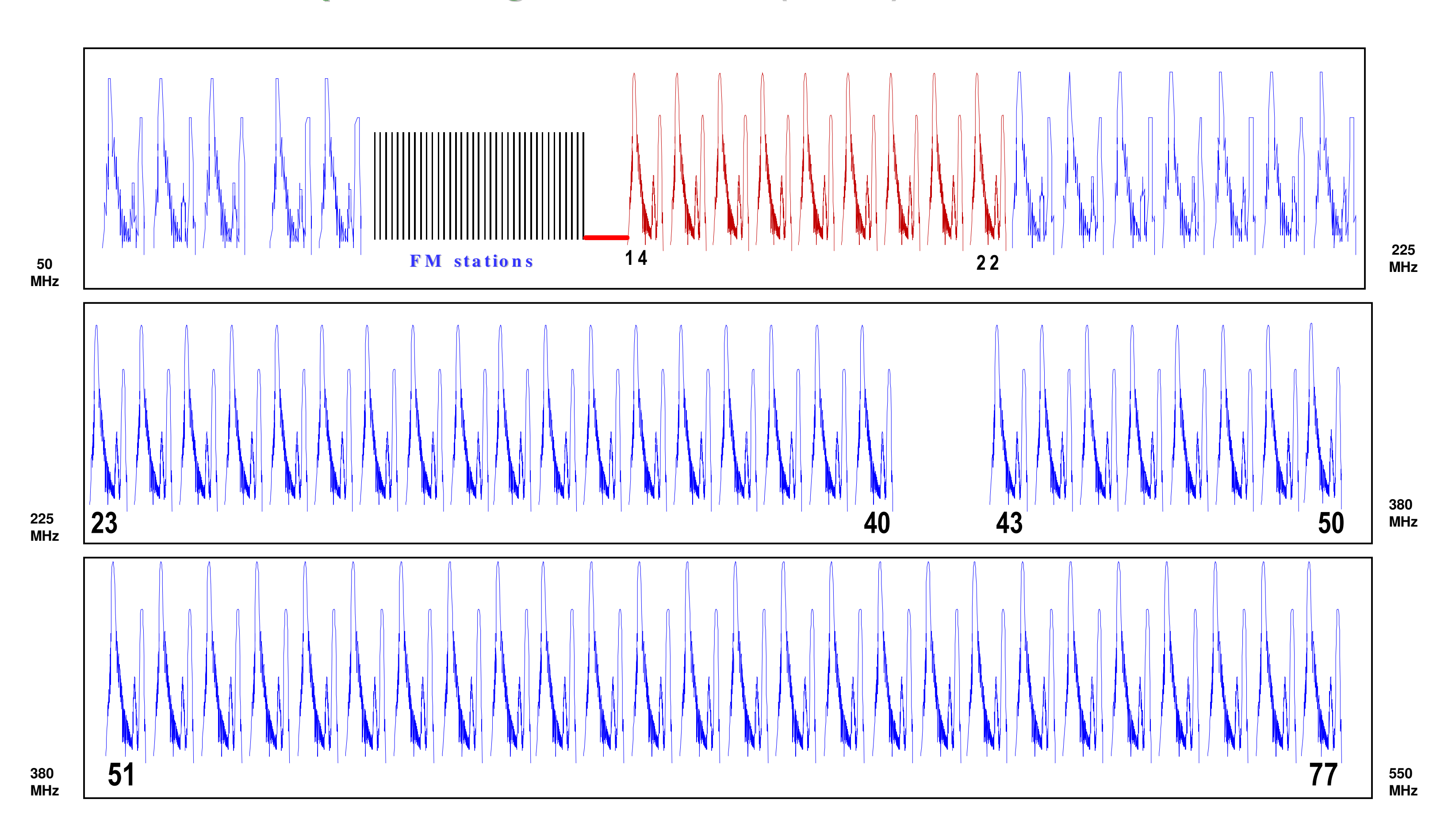
A Modern CATV Headend



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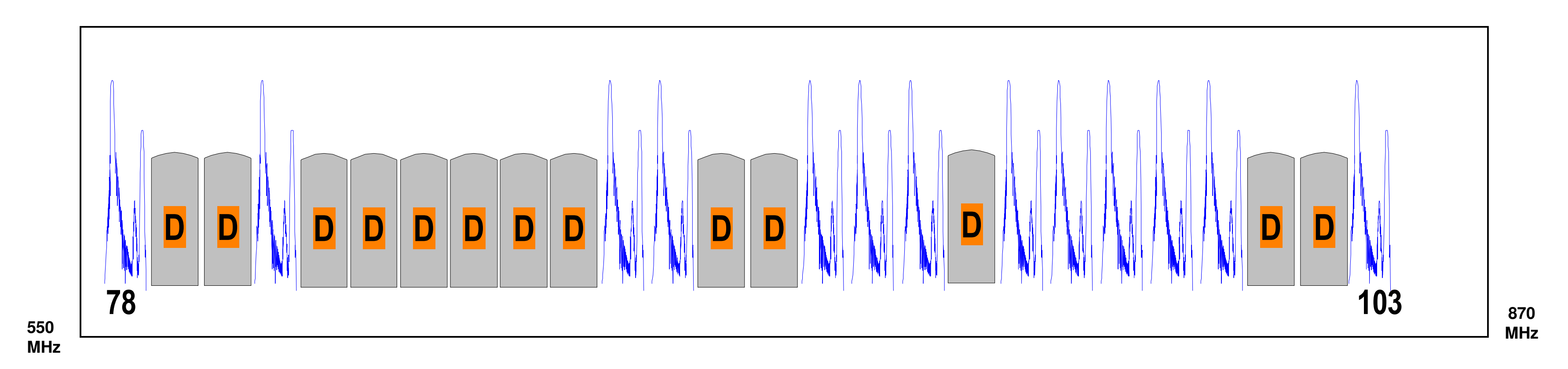
Channel Plan of a HFC System.

In a modern Broadband system, the frequencies below 550 MHz are generally used for the transport analogical channels (NTSC).



Channel Plan of a HFC System.

In a modern Broadband system, the frequencies above 550 MHz are generally used for the transport of the digital portion of the HFC system. QAM digital channels and standard television channels can well exits side by side.

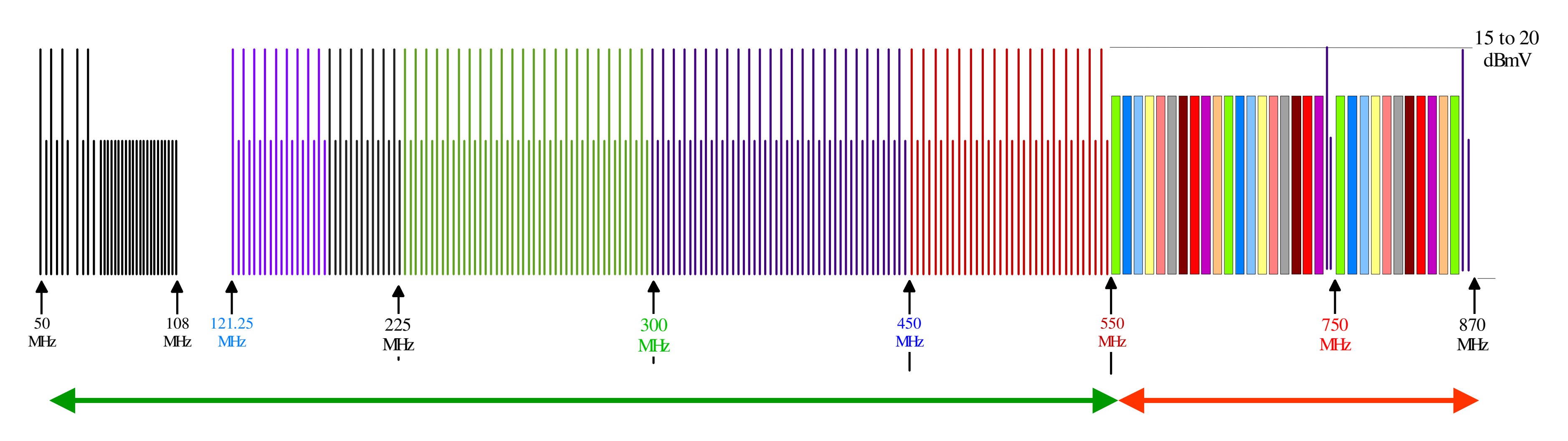


D *= Digital, Data, IP Telephony, Video On Demand*

Standard Television channels can be replaced by digital television or other digital services (Data, Cablemodem, Security system, IP Telephony system, etc.) on a modern HFC system.

Signals Carried by a HFC System.

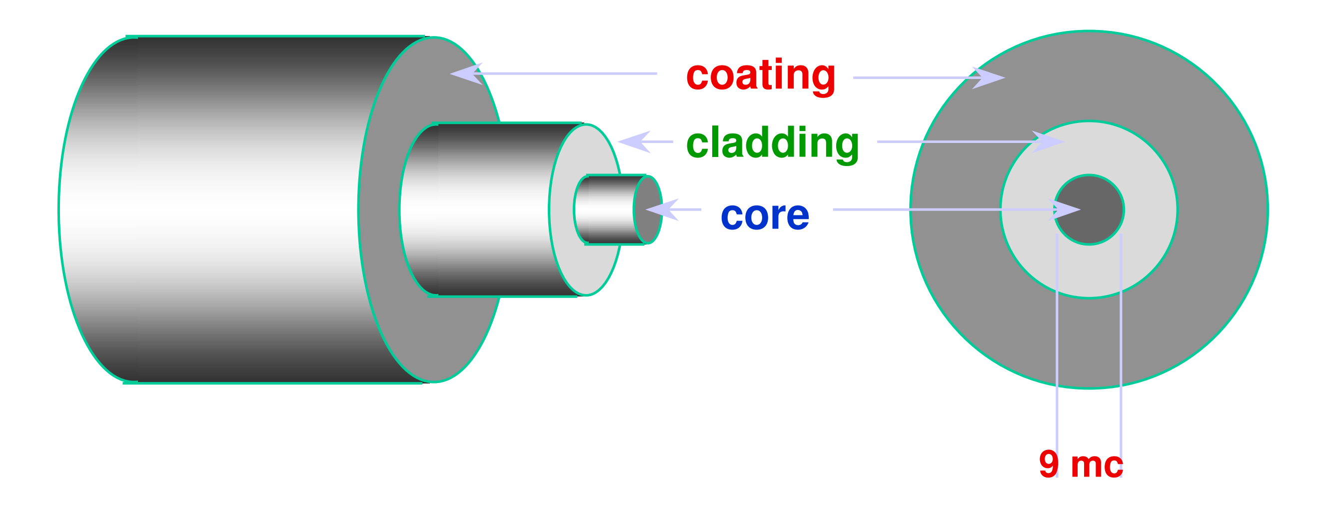
Response of a 870 MHz HFC system



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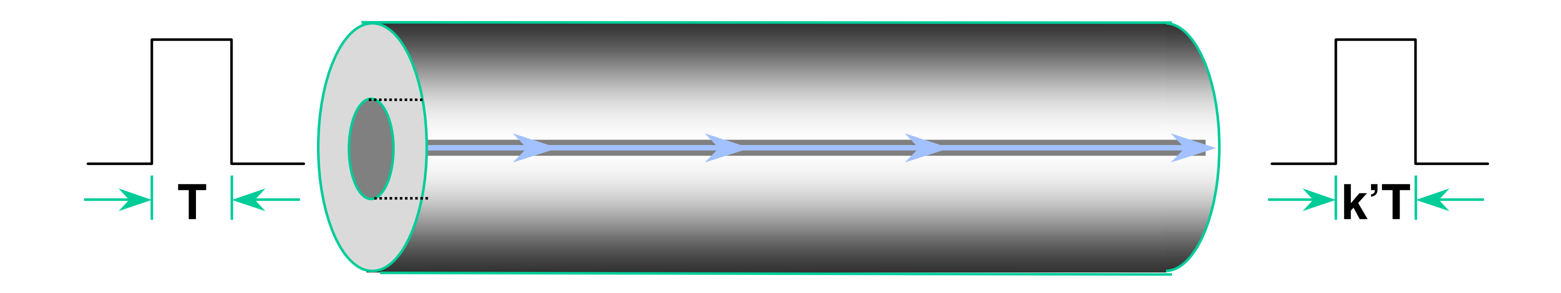
The Fiber Optic Section.

Fiber Optic Cable.



The transmitted light is guided down the fiber by reflecting off the outside of the core. The core's index of refraction is slightly higher than that of the surrounding cladding to insure internal refraction. The core is surrounded by optical material called the cladding. The cladding causes the light to remain inside the core. The core and the cladding are usually made of ultra-pure glass called silica. The materials need to be ultra-pure because impurities in the material can lead to a reduction of power output. Impurities can add to absorption and scattering, which would reduce the effectiveness of the fiber. The buffer coating covers the core and the cladding. The buffer coating is generally made of plastic, which protects the fiber from moisture and other damages.

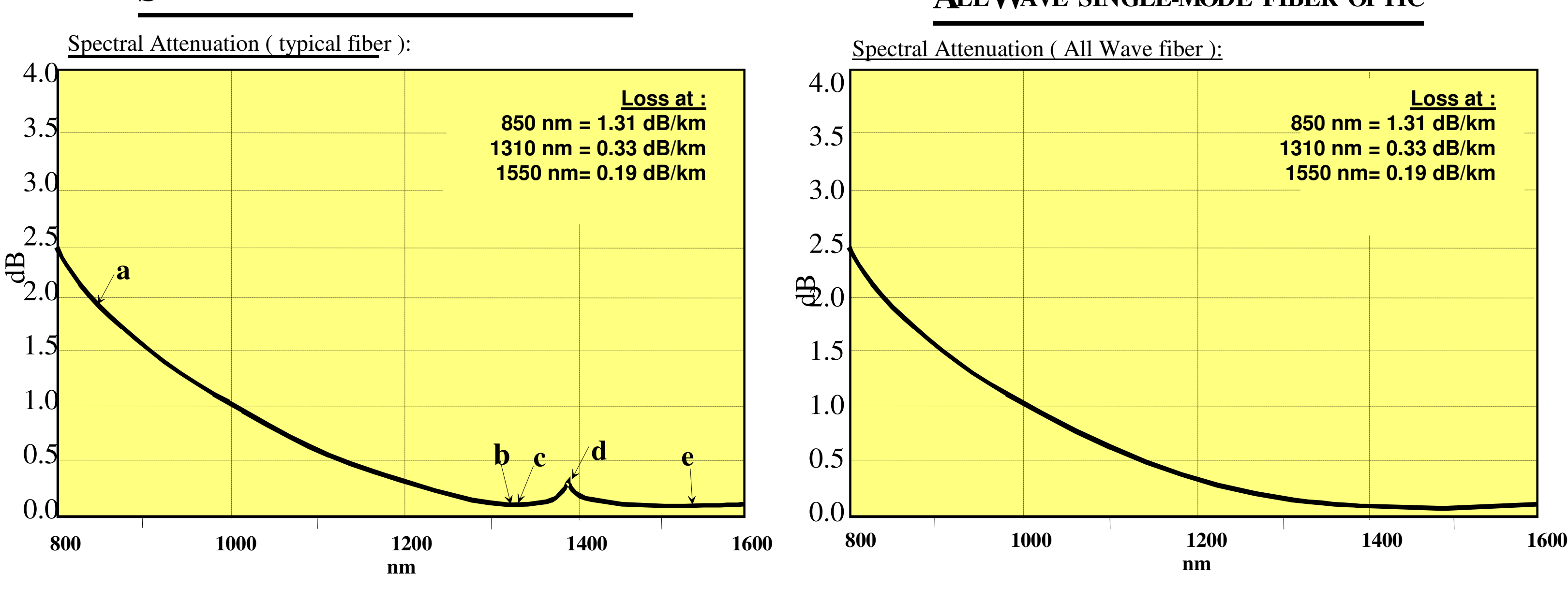
Single Mode Fiber Optic Cable.



Mono-mode fiber optic operating frequencies in a HFC system are 1310 or 1550 nanometers.

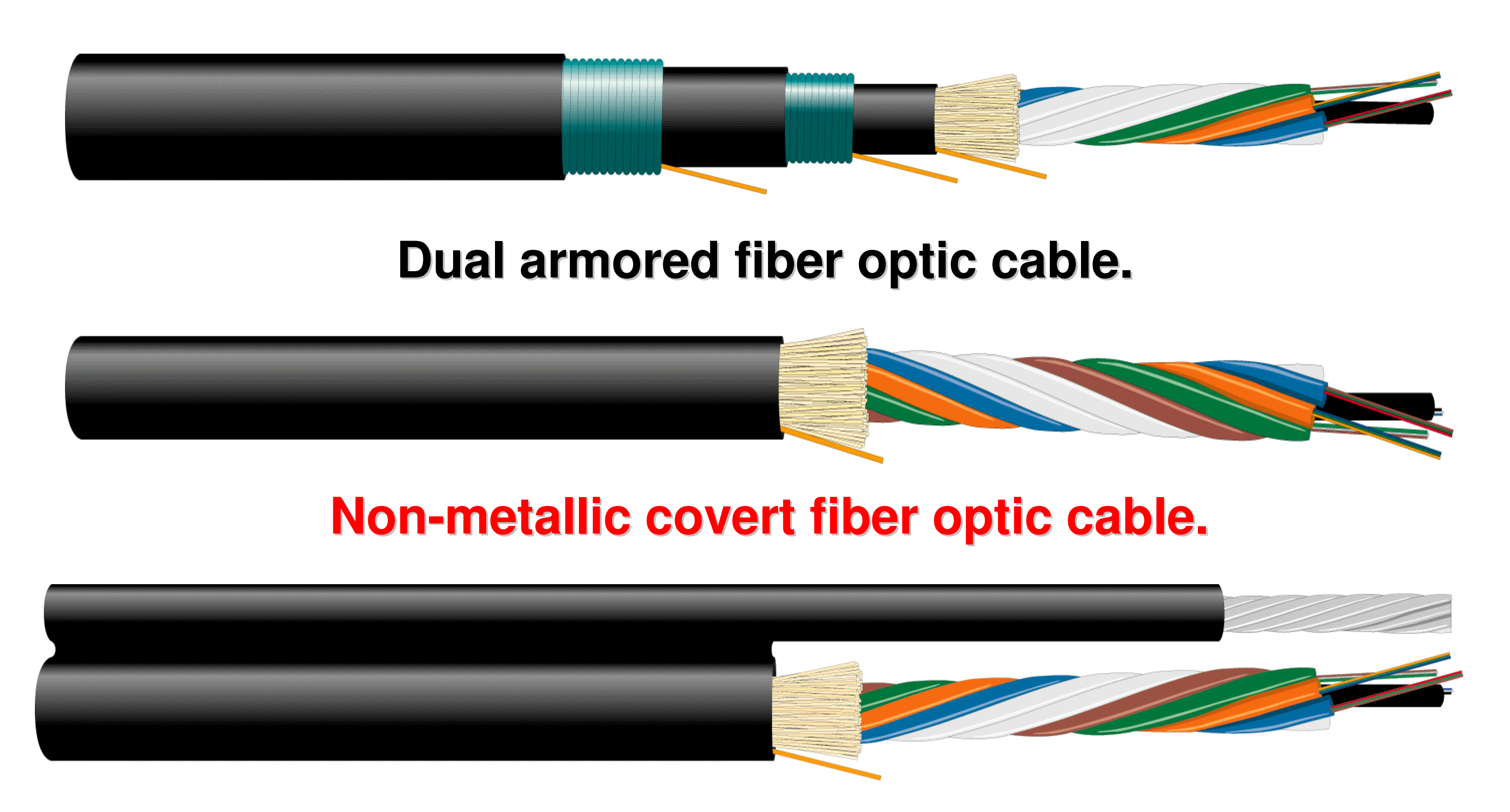
Fiber Optic Light Frequency.

Performance Characteristics of single mode fiber optic.



The standard fiber optic is mostly used for every day signal transport.
The new AllWave fiber is used for the DWDM and long distance transport.
Notice that the humidity peak at 1400 nm, have been removed on AllWave fiber

Fiber Optic Cable.

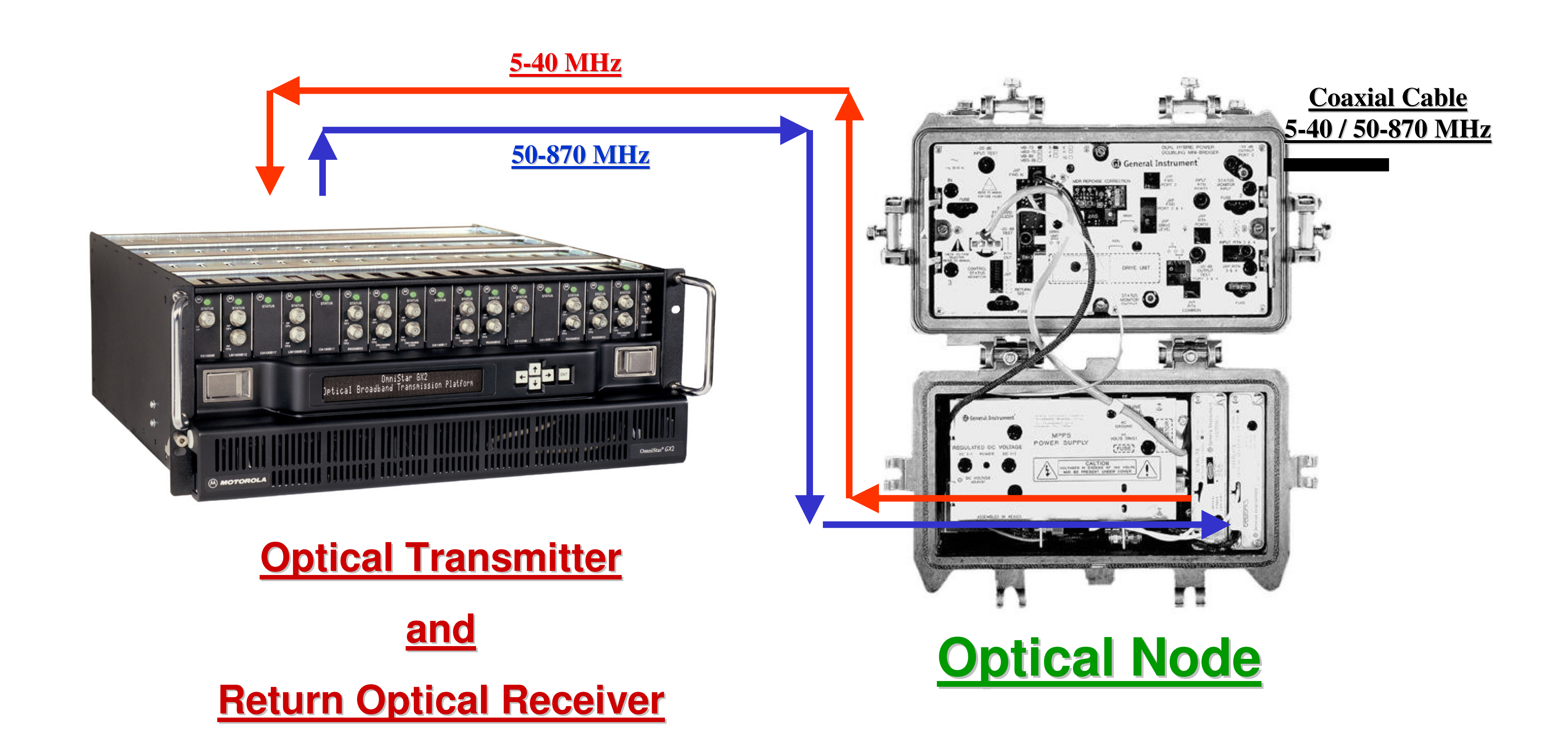


Dual armored fiber optic cable.

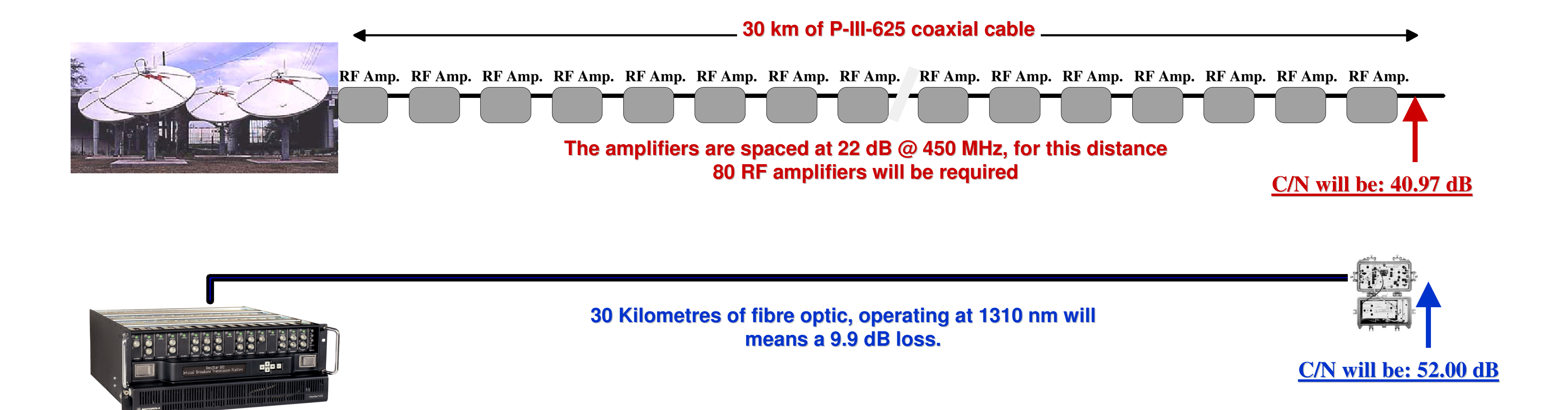
Non-metallic covert fiber optic cable.

Fig-8 Self supporting fiber optic cable.

Optical Transport System.



Why use Fiber Optic.



Above, shows advantage of fiber optic, over coaxial cable, which are:

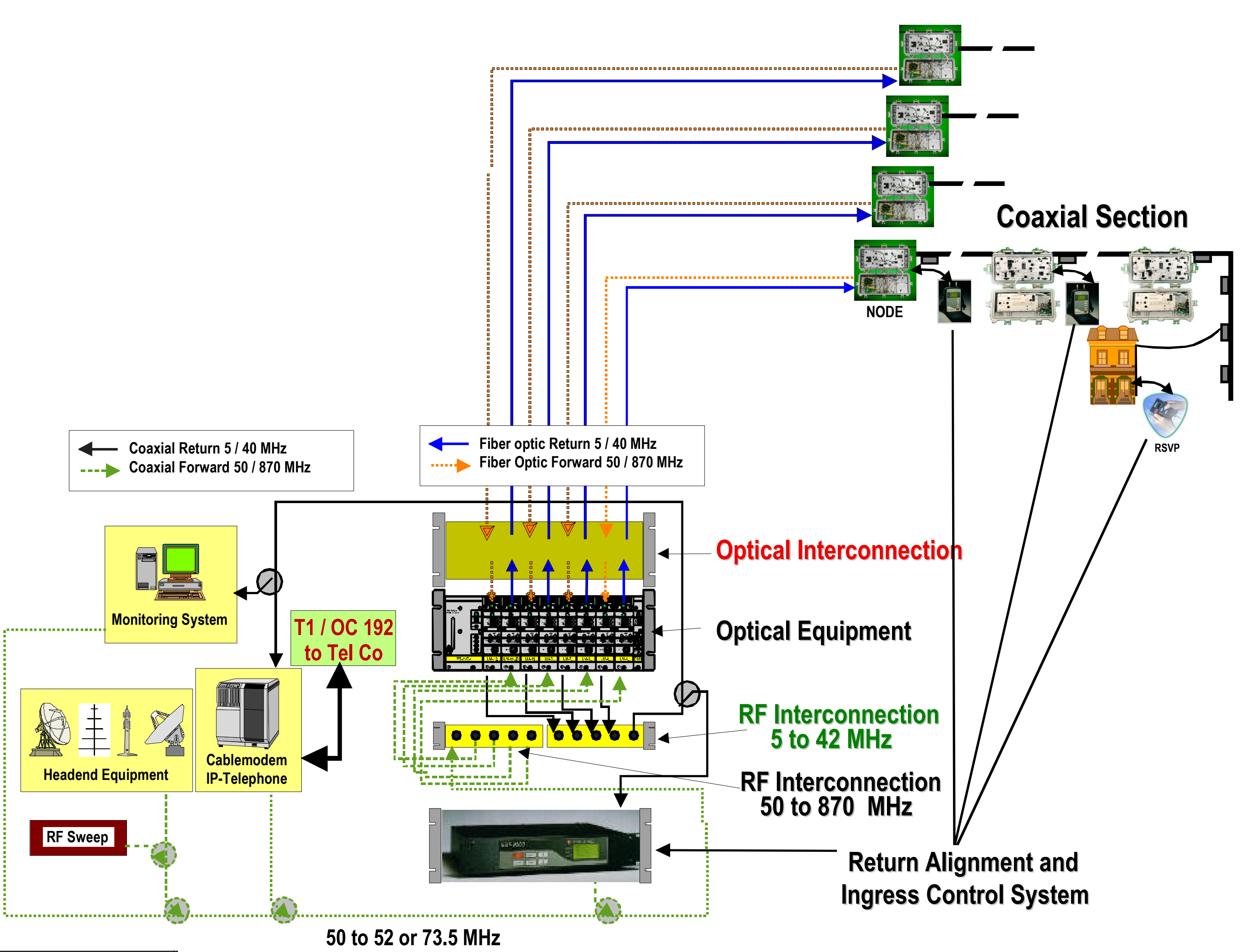
- Better Carrier to Noise, CTB, CSO specifications at the end of the system.
- The 30 km fibre link will give more stable signal even with temperature change.
- The fibre optic link will require less actives equipments than the coaxial link.
- A 30 km coaxial section will require 80 amplifiers.
- A 30 km fiber optic link will require a 10 dBm optical transmitter and one optical receiver.

Verification of a Fiber Optic Link.

An OTDR uses microwave technology to verify the quality and the length of fiber optic.



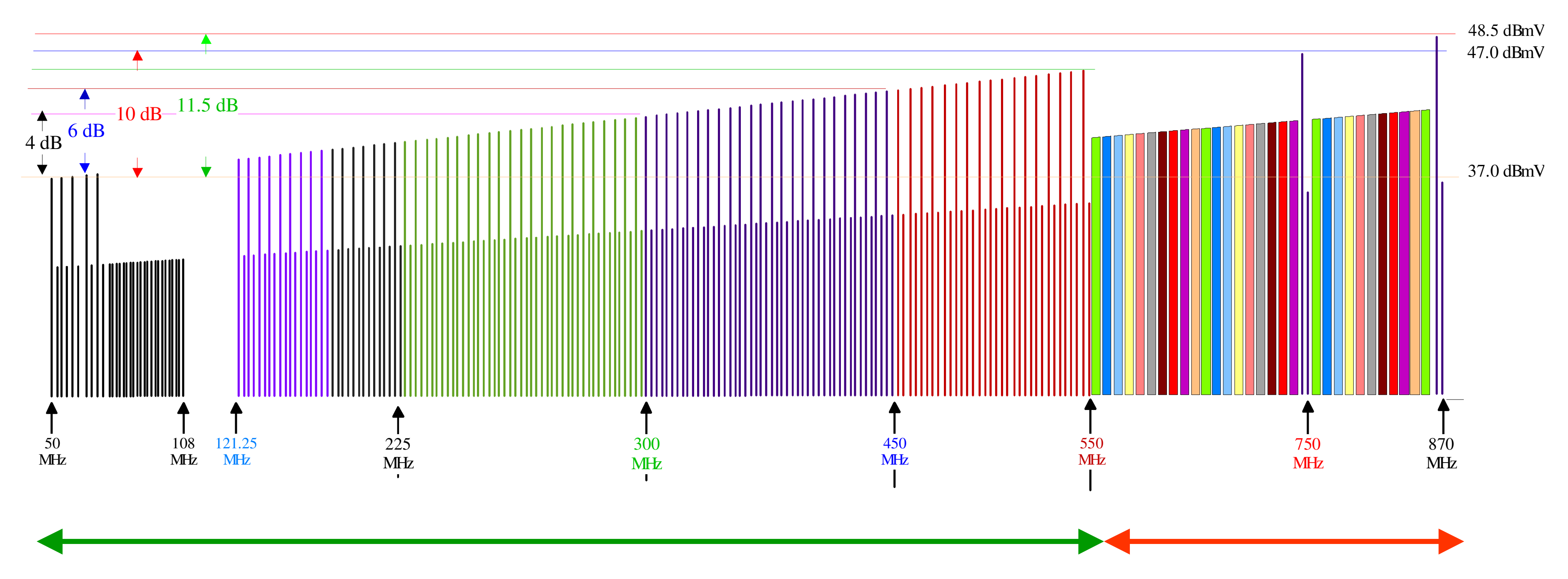
A HFC System.



Coaxial Section
NODE
RSVP
Coaxial Return 5 / 40 MHz
Coaxial Forward 50 / 870 MHz
Fiber optic Return 5 / 40 MHz
Fiber Optic Forward 50 / 870 MHz
Optical Interconnection
Optical Equipment
Monitoring System
T1 / OC 192
to Tel Co
RF Interconnection
5 to 42 MHz
RF Interconnection
50 to 870 MHz
Headend Equipment
Cablemodem
IP-Telephone
RF Sweep
Return Alignment and
Ingress Control System
50 to 52 or 73.5 MHz

Signals Carried by a HFC System.

Response of a Optical Receiver or a RF amplifier for a 870 MHz HFC system.

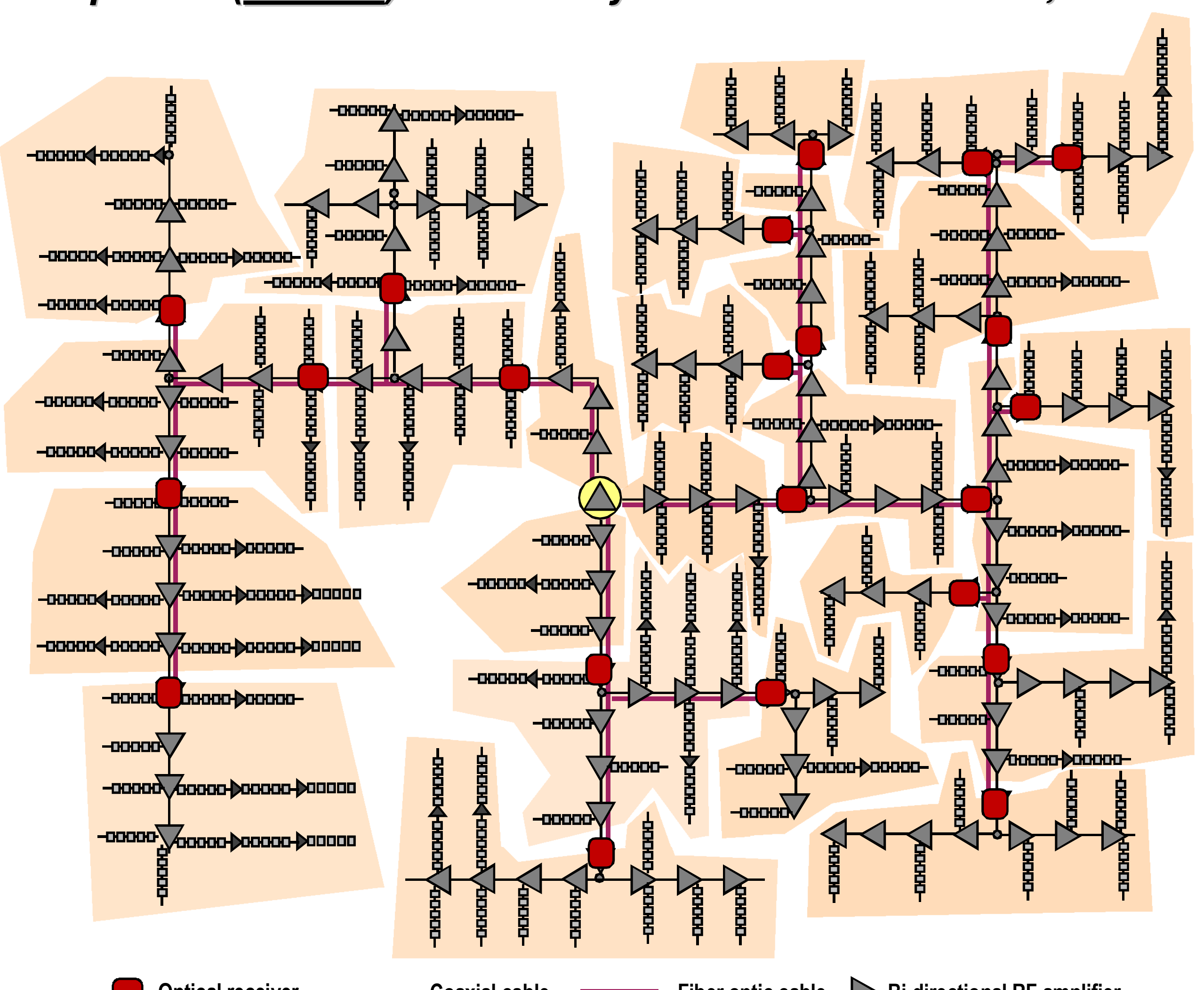


80 NTSC, Analog channels.

220 MHz of 64 or 256 QAM signals.

Bi-Ditectionnel HFC System.

Each pocket (<u>section</u>) of a HFC system can have 50 to 1,500 subs.



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Future seminars will include.

- •Headend of a HFC system.
- •Description of a HFC Headend.
- •Coaxial cable - Fiber optic.
- •Passive equipments for a HFC system.
- •Description of the outside plan.
- •RF Amplifiers.
- •Fiber optic.
- •Fiber optic management.
- •System distortion calculation.
- •Understanding bi-directionality.
- •Adjusting a HFC system.
- •Home installation.
- •Test equipments required for a HFC system.
- •CLI. (Ingress & Egress)
- •CMTS, DOCSIS, QAM signal. Cablemodem.

The end for this section.